What is claimed is:

1. A method for receiving high frequency signals transmitted through free space, comprising:

passing an one or more optical signals, the one or more optical signals containing data and being composed of radiation of a plurality of differing wavelengths, through a diffractive optical element to form a plurality of signal segments, each signal segment having a different mean wavelength; and

detecting data in each of said plurality of signal segments at a different spatial location.

2. A method, as claimed in Claim 1, further comprising, before the passing step:

transmitting each of said optical signals through atmospheric distortion at a data rate that is greater than one gigabit/second for each wavelength.

3. A method, as claimed in Claim 1, wherein the diffractive optical element is a hologram, a zone plate, or combination thereof.

4. A method, as claimed in Claim 3, wherein a first portion of the optical signal is passed through a phase retarder located in a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the phase retarder and wherein said first portion is the radiation in the optical signal that contacts the diffractive optical element

within a radial distance of a center of the diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

5. A method, as claimed in Claim 1, wherein:

in the detecting step, each of the plurality of signal segments is detected by a different detector.

6. A method, as claimed in Claim 1, wherein:

in the detecting step, the mean wavelength of at least one of the signal segments is reduced before the at least one of the signal segments contacts a detector.

7. A method, as claimed in Claim 6, wherein at least one of the following conditions is true before a signal segment contacts a detector:

the spot size of the signal segment is reduced by a lens;

the mean wavelength of the signal segment is reduced by a lens; and

the intensity of a signal segment is increased by a lens.

8. A method, as claimed in Claim 1, wherein:

after the passing step and before the detecting step, the plurality of signal segments are reflected by a reflective surface.

9. A method, as claimed in Claim 1, wherein:

the optical signal has a beam size at an aperture of a source transmitter associated with the optical signal that is less than an atmospheric inner scale.

10. A method, as claimed in Claim 9, wherein the beam size at the transmitter is no more than about 10 mm.

11. A method for receiving high frequency signals transmitted through free space, comprising:

dividing an optical signal, the optical signal containing data and being composed of radiation of a plurality of differing wavelengths, into a plurality of signal segments, each signal segment having a different mean wavelength; and

detecting, with a plurality of spaced apart detectors, data in each of said plurality of signal segments.

12. A method of Claim 11, wherein each of the detectors in located in an end-to-end configuration relative to an adjacent detector.

13. The method of Claim 12, wherein the longitudinal axes of each of the detectors are at least substantially parallel to one another.

14. The method of Claim 13, wherein the longitudinal axes are at least substantially collinear.

15. The method of Claim 11, wherein in the dividing step the optical signal is passed through a diffractive optical element and a first portion of the optical signal is passed through one or more phase retarders.

16. A method, as claimed in Claim 15, wherein:

the first portion of the optical signal contacts a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the one or more phase retarders.

17. A method, as claimed in Claim 15, wherein:

said first portion is the radiation in the optical signal that contacts the diffractive optical element within a radial distance of a center of the diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

18. A method, as claimed in Claim 11, wherein:

in the detecting step, the spot size of at least one of the signal segments is reduced by a lens before the at least one of the signal segments contact a detector.

19. A method, as claimed in Claim 18, wherein:

the spot size is reduced by an immersion lens.

20. A method, as claimed in Claim 11, wherein:

after the dividing step and before the detecting step, the plurality of signal segments are reflected by a reflective surface.

21. A method, as claimed in Claim 11, wherein in the dividing step:

said optical signal is focused with a diffractive optical element.

22. A method, as claimed in Claim 11, wherein:

the optical signal has a beam size at an aperture of a source transmitter associated with the optical signal that is less than an atmospheric inner scale.

23. A method, as claimed in Claim 22, wherein the beam size is no more than about 10 mm.

24. An apparatus for receiving an optical signal transmitted through free space, the optical signal being composed of radiation of a plurality of wavelengths, comprising:

at least one diffractive optical element for focusing radiation of different wavelengths at different focal points; and

a plurality of detectors, each detector being located at or near a different one of the focal point and receiving the radiation focused on the focal point corresponding to the detector.

25. An apparatus, as claimed in Claim 24, wherein:

the plurality of detectors are positioned at spaced apart locations along an axis of the optical lens.

26. An apparatus, as claimed in Claim 24, wherein:

an immersion lens is located between each of the detectors and the at least one diffractive optical element to reduce a spot size associated with radiation converging on the respective detector.

27. An apparatus, as claimed in Claim 24, further comprising:

a reflective surface positioned on a first side of the at least one diffractive optical element.

28. An apparatus, as claimed in Claim 27, wherein:

at least some of the plurality of detectors are located in a hole in the at least one diffractive optical element.

29. An apparatus, as claimed in Claim 27, wherein:

at least some of the plurality of detectors are located on a second side of the one or more diffractive optical elements, the second side being in an opposing relationship with the first side.

30. An apparatus, as claimed in Claim 27, wherein:

the plurality of detectors are located between the reflective surface and the at least one diffractive optical element and along an axis of the at least one diffractive optical element.

31. An apparatus, as claimed in Claim 24, wherein:

the at least one diffractive optical element has an obscuration and at least one of the plurality of detectors is located in a shadow of the obscuration with respect to radiation

having a wavelength different from a wavelength of radiation converging on the at least one detector.

32. An apparatus, as claimed in Claim 26, wherein:

at least one of the detectors is integral with the corresponding immersion lens.

33. An apparatus, as claimed in Claim 26, wherein:

a plurality of the immersion lenses and a corresponding number of detectors have at least substantially parallel and collinear central axes and the central axes of the immersion lenses and corresponding detectors are at least substantially parallel and collinear with an optical axis of the at least one diffractive optical element.

34. An apparatus, as claimed in Claim 24, wherein an aperture size of the holographic unit exceeds the Fresnel scale.

35. An apparatus for receiving an optical signal transmitted through free space, the optical signal containing data, comprising:

a first lens for focusing radiation;

a detector positioned to receive the focused radiation; and

a second lens located between the first lens and the detector, the second lens reducing a spot size of the focused radiation after passing through the second lens.

36. An apparatus, as claimed in Claim 35, wherein:

the optical signal includes radiation of a plurality of wavelengths and the first lens focuses radiation of different wavelengths at different focal points and further comprising:

a plurality of detectors, each detector being located at or near a respective focal point and receiving the radiation focused on the respective focal point.

37. An apparatus, as claimed in Claim 36, wherein:

the plurality of detectors are positioned at spaced apart locations along an axis of the first lens.

38. An apparatus, as claimed in Claim 36, wherein:

the second lens is an immersion lens and a respective immersion lens is located between each of the detectors and the first lens to reduce a spot size associated with radiation converging on the corresponding detector.

39. An apparatus, as claimed in Claim 36, further comprising:

a reflective surface positioned on a first side of the first lens.

40. An apparatus, as claimed in Claim 39, wherein:

at least some of the plurality of detectors are located in a hole in the first lens.

41. An apparatus, as claimed in Claim 39, wherein:

at least some of the plurality of detectors are located on a second side of the first lens, the second side being in an opposing relationship with the first side.

42. An apparatus, as claimed in Claim 39, wherein:

the plurality of detectors are located between the reflective surface and the first lens and along an axis of the first lens.

43. An apparatus, as claimed in Claim 36, wherein:

the first lens has an obscuration and at least one of the plurality of detectors is located in a shadow of the obscuration with respect to radiation having a wavelength different from a wavelength of radiation converging on the at least one detector.

44. An apparatus, as claimed in Claim 38, wherein:

at least one of the detectors is integral with the respective immersion lens.

45. An apparatus, as claimed in Claim 35, wherein the second lens is an immersion lens having an index of refraction of at least about 2.3, having a radius of curvature ranging from about 400 to about 600 microns.

46. An apparatus, as claimed in Claim 35, wherein the second lens has a radius ranging from about 200 to about 300 microns.

47. A method for receiving high frequency signals transmitted through free space, comprising:

first passing an optical signal, the optical signal containing data, through a first lens to form focused radiation having a first mean wavelength;

second passing the focused radiation through a second lens to form converging radiation having a second mean wavelength, the first mean wavelength being different than the second mean wavelength; and

detecting data in the convergent radiation.

48. A method, as claimed in Claim 47, wherein:

the optical signal is composed of radiation of a plurality of differing wavelengths; in the first passing step the first lens is a diffractive optical element; the focused radiation includes a plurality of signal segments, each signal segment having a different mean wavelength; and in the first passing step only a first portion of the optical signal is passed through a phase retarder.

49. A method, as claimed in Claim 47, further comprising, before the first passing step:

transmitting said optical signal through atmospheric distortion at a first rate that is greater than one gigabit/second.

50. A method, as claimed in Claim 48, wherein:

the first portion of the optical signal contacts a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the phase retarder.

51. A method, as claimed in Claim 50, wherein:

said first portion is the radiation in the optical signal that contacts the diffractive optical element within a radial distance of a center of the diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

52. A method, as claimed in Claim 47, wherein:

in the detecting step, each of the plurality of signal segments is detected by a different detector.

53. A method, as claimed in Claim 47, wherein:

the second lens is an immersion lens.

54. A method, as claimed in Claim 48, wherein:

after the first passing step and before the second passing step, the plurality of signal segments are reflected by a reflective surface.

55. A method, as claimed in Claim 47, wherein:

the optical signal has a beam size at an aperture of a source transmitter associated with the optical signal that is less than an inner scale.

56. A method, as claimed in Claim 55, wherein the beam size is no more than about 10 mm.

57. An apparatus for receiving an optical signal, the optical signal containing data, comprising:

a first lens for focusing the radiation in the optical signal;

a reflective surface for reflecting the focused optical signal and forming a reflected optical signal; and

a detector positioned to receive the reflected optical signal, the detector being located between the first lens and the reflective surface.

58. An apparatus, as claimed in Claim 57, further comprising:

a second lens located between the reflective surface and the detector, the second lens reducing a wavelength of the reflected optical signal, whereby a spot size of the reflected optical signal is reduced after passing through the second lens.

59. An apparatus, as claimed in Claim 57, wherein:

the optical signal includes radiation of a plurality of wavelengths and the first lens focuses radiation of different wavelengths at different focal points and further comprising:

a plurality of detectors, each detector being located at or near a different focal point and receiving the radiation focused on the adjacent focal point corresponding to the detector.

60. An apparatus, as claimed in Claim 59, wherein:

the plurality of detectors are positioned at spaced apart locations along an axis of the first lens.

61. An apparatus, as claimed in Claim 58, wherein:

the second lens is an immersion lens and a respective immersion lens is located between each of a plurality of detectors and the first lens to reduce a spot size associated with radiation converging on the respective detector.

62. An apparatus, as claimed in Claim 59, wherein:

at least some of the plurality of detectors are located in a hole in the first lens.

63. An apparatus, as claimed in Claim 59, wherein:

at least some of the plurality of detectors are located on a second side of the first lens, the second side being in an opposing relationship with the first side.

64. An apparatus, as claimed in Claim 59, wherein:

the plurality of detectors are located between the reflective surface and the first lens and along an axis of the first lens.

65. An apparatus, as claimed in Claim 59, wherein:

the first lens has an obscuration and at least one of the plurality of detectors is located in a shadow of the obscuration with respect to radiation having a wavelength different from a wavelength of radiation converging on the at least one detector.

66. An apparatus, as claimed in Claim 59, wherein:

at least one of the detectors is integral with the respective immersion lens.

67. An apparatus, as claimed in Claim 57, wherein the first lens has a focal length and the reflective surface is located at a distance from the first lens that is approximately equal to 50% of the focal length.

68. A method for receiving an optical signal transmitted through free space, comprising:

first passing the optical signal, the optical signal containing data, through a first lens to form a plurality of signal segments, each corresponding to a different median wavelength, wherein the first lens is a diffractive optical element;

reflecting the plurality of signal segments off a reflective surface to form reflected radiation; and

detecting data in the reflected radiation.

69. A method, as claimed in Claim 68, wherein:

in the first passing step a first portion of the optical signal is passed through a phase retarder.

70. A method, as claimed in Claim 69, wherein:

the first portion of the optical signal contacts a central portion of the diffractive optical element and wherein the first portion of the optical signal has a different phase than a second portion of the optical signal that is not passed through the phase retarder.

71. A method, as claimed in Claim 69, wherein:

said first portion is the radiation in the optical signal that contacts the diffractive optical element within a radial distance of a center of the at least one of a holographic unit, diffractive optical element while said second portion is the radiation that contacts the diffractive optical element outside the radial distance.

72. A method, as claimed in Claim 68, wherein:

in the detecting step, each of the plurality of signal segments is detected by a different detector.

73. A method, as claimed in Claim 68, further comprising:

second passing the reflected radiation through a second lens to form converging radiation having a median wavelength different from the reflected radiation.

74. A method, as claimed in Claim 73, wherein:

the second lens is an immersion lens.

75. A method, as claimed in Claim 68, wherein:

the optical signal has a beam size that is less than a size of an inner scale in the vicinity of the source transmitter.

76. A method, as claimed in Claim 75, wherein the beam size is no more than about 10 mm.

77. A method of manufacturing a detector assembly, comprising:

forming an optical detector on an at least substantially transparent substrate, the optical detector being on a first side of the substrate; and

forming, on an opposed second side of the substrate, a lens, the lens having a refractive index such that a median wavelength of radiation passing through the lens is reduced.

78. A method, as claimed in Claim 77, wherein the lens acts as an immersion lens.

79. A method, as claimed in Claim 77, further comprising:

providing a waveguide to provide electrical contact with the detector.

80. A method, as claimed in Claim 79, wherein the substrate is contacted with a waveguide and the ground plane of the waveguide has a width ranging from about 100 to about 1,000 microns, the conductor of the waveguide has a width ranging from about 5 to about 200 microns, and the distance between the conductor and the ground plane ranges from about 2 to about 100 microns.

81. A method, as claimed in Claim 79, wherein the substrate is contacted with a waveguide and the ground plane of the waveguide has a width of no more than about 2 mm waveguide, and the distance between the conductor and the ground plane is no more than about 50% of the width of the conductor.

82. A method, as claimed in Claim 77, wherein the curved surface has a radius of curvature ranging from about 300 to about 600 microns.

83. A method, as claimed in Claim 77, wherein an area of a photoactive region of the optical detector is no more than about 10% of an area of the curved surface.

84. A method, as claimed in Claim 77, wherein the second forming step comprises aligning the curved surface with the optical detector.

85. A method, as claimed in Claim 81, wherein the aligning step is performed by one or more of infrared microscopy, and mechanical metrology.

86. A method, as claimed in Claim 77, wherein the second forming step includes

engaging a mask with a surface of the substrate; and

etching the substrate to form the curved surface.

87. A method, as claimed in Claim 77, wherein the second forming step includes reducing a thickness of the substrate.

88. A method, as claimed in Claim 77, wherein in the first forming step a plurality of optical detectors are formed simultaneously on the substrate and in the second forming step a plurality of curved surfaces are formed simultaneously on the substrate and further comprising:

separating the substrate to form a plurality of discrete substrate portions, each including a optical detector and a curved surface.

89. A method, as claimed in Claim 77, further comprising:

bonding the substrate, including the optical detector and curved surface, to a second substrate.